# MASTER OF SCIENCE
# IN
# PHYSICS

**IMPACT ANALYSIS OF A BIOMECHANICAL MODEL OF THE HUMAN THORAX**

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The biomechanical response of a finite element model of the human thorax and a protective body armor system was studied under impact loading from a projectile. The objective of the study was to create a viable finite element model of the human thorax. This objective was accomplished through the construction of a three-dimensional finite element model in DYNA3D, a finite element analysis program. The model was validated by comparing the results of tests of body armor systems conducted on cadavers to results obtained from finite element analysis. A parametric study was undertaken to determine the essential components of the model. The results from this investigation determined that the path of force propagation from a body armor system to the thorax upon bullet impact is directly through the vest to the sternum and then through the skeleton to the rest of the body. Thus, any parameters that affect the components in this pathway were essential to the model. This included the muscles, their geometries, material properties, and viscosity, as well as the Young's modulus of the sternochondral cartilage and the bones themselves.

**DoD KEY TECHNOLOGY AREAS:** Clothing, Textiles, and Food, Modeling and Simulation, Other (Biomechanical)

**KEYWORDS:** Finite Element Analysis, Human Thorax Model, Impact Analysis

**TERRAIN CATEGORIZATION USING MULTISPECTRAL AND MULTITEMPORAL IMAGERY (U)**

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Abstract is classified.

**DoD KEY TECHNOLOGY AREAS:** Battlespace Environments, Sensors

**KEYWORDS:** Sensor Fusion, Multitemporal, Terrain Categorization, Imagery Intelligence

**OBSERVATIONS OF QUASI-NONRADIATING WAVE SOURCES IN ONE DIMENSION**

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A nonradiating wave source is one that drives waves over a region of a medium, where no waves propagate outside the region due to complete destructive interference at the boundary. This thesis describes the first observations of an acoustical source of this type. Physical observations are made with a current-carrying wire that is transversely driven by several types of magnetic field distributions. The wire glows as a result of the current, and the wave pattern can be observed due to the cooling caused by the motion of the wire. The predicted standing wave response in the source region is confirmed. Numerical simulations of a one-dimensional mass-and-spring lattice show that dissipation, nonuniformity, and nonlinearity each cause radiation to escape from the source region. The radiation amplitude relative to the standing wave amplitude is substantially reduced for sources that are distributed over a region rather than lumped over the same region. In addition, it is possible to make adjustments to the drive parameters to substantially minimize the radiation.

**DoD KEY TECHNOLOGY AREAS:** Modeling and Simulation, Other (Nonradiating Wave Sources)

**KEYWORDS:** Nonradiating Waves, Noise Cancellation